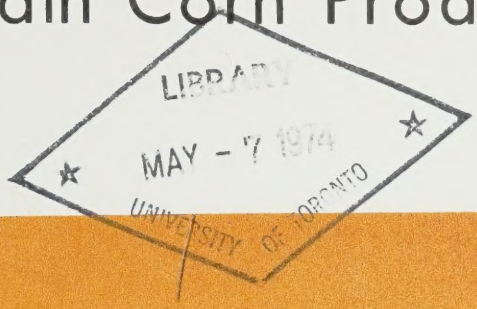
working paper on:

Production Practices, Costs, and Returns in Quebec Grain Corn Production



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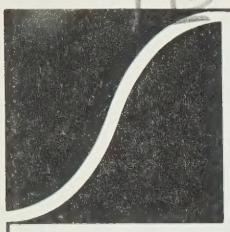

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Production Practices, Costs, and Returns in Quebec Grain Corn Production

A Federal Employment Stimulation Project

Farm Management Division
Agriculture Canada
550 Sherbrooke Street, West
Room 1550
Montréal 111, P. Q.

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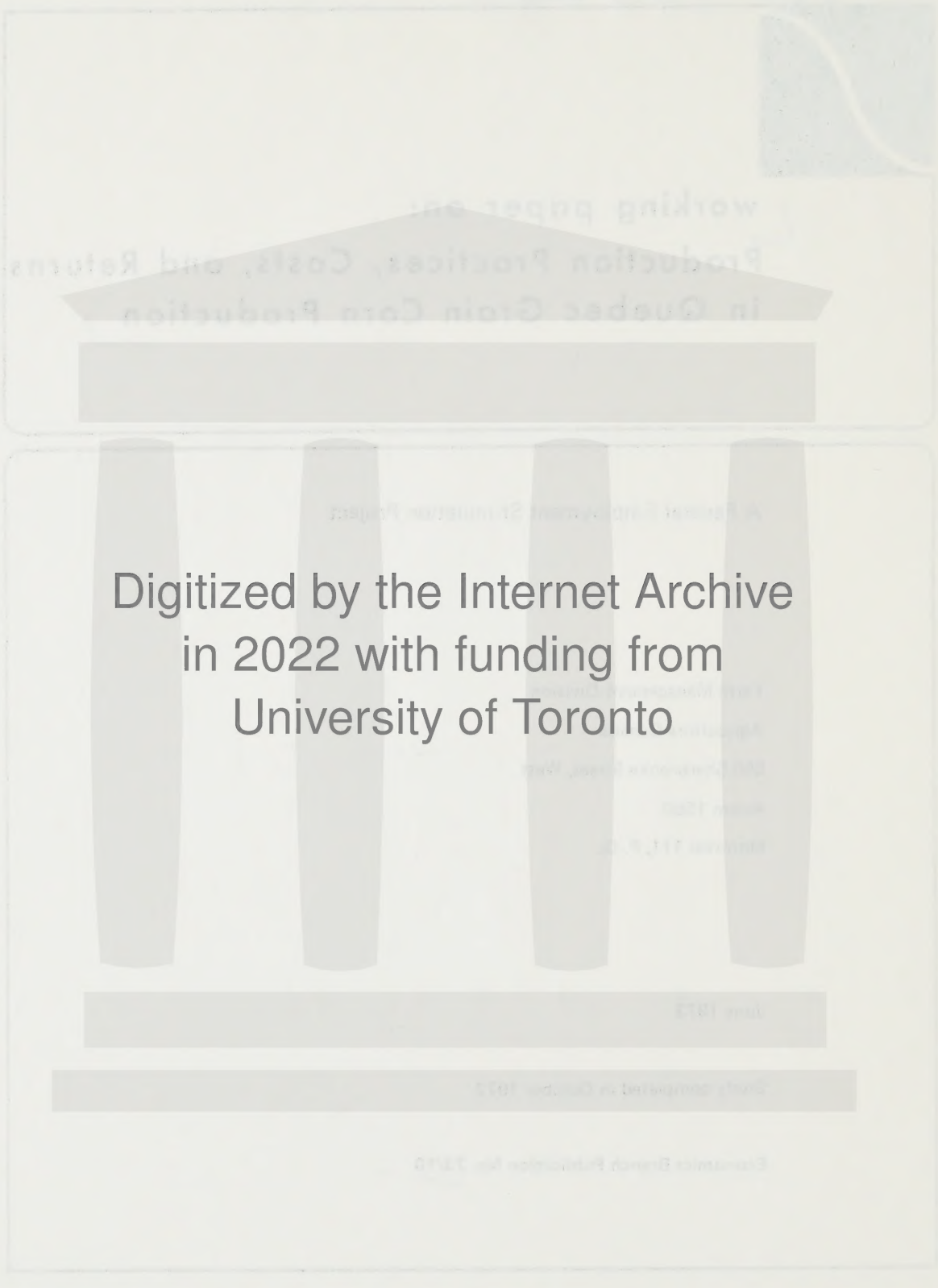

FOREWORD

This is a report on one of a series of socio-economic surveys or studies on farm adjustment in the Province of Quebec. These were initiated and carried out in 1970-1971 and 1971-1972 by the Farm Management Division in Montreal of the Canada Department of Agriculture under the Economic Stimulation Programme.

Within the scope of a broad conceptual framework, the Farm Management Division in Montreal identified two distinct types of adjustment taking place in Quebec agriculture:

(1) Adjustment within agriculture by farmers switching from one agricultural enterprise to another offering a higher growth potential.

(2) Adjustment out of agriculture by farmers giving up their agricultural activity and either becoming inactive (i.e. retiring) or taking up employment in other occupations, for instance, in the manufacturing industry or in one of the growing service industries.

Intensive corn production was one of the enterprises which seems to have a very high-growth potential for farmers in the Montreal Plain. Thus it would appear to offer an attraction to farmers wishing to transfer from low-growth enterprises such as milk production.

Because of the scarcity of data on corn production in Quebec where climatic conditions are favourable, the Farm Management Division in Montreal decided to analyze production practices, costs and returns of this crop.

This study could not have been accomplished without a large input of assistance, always given generously, by many officials of the Quebec Department of Agriculture and Colonization, particularly those in the Region offices of the Department. The same acknowledgement must be made to many officers of the Canada Department of Agriculture, particularly those working in Quebec.

Throughout the development of the research on corn production, assistance and advice of members of staff of Macdonald College were freely given and were greatly appreciated. The generous assistance of the regional co-ordinators, county agronomes, and other specialists of the Quebec Department of Agriculture and Colonization is gratefully acknowledged. Particular appreciation is due to Mr. René Crète of the Canada Department of Agriculture (C.D.A.) Research Station in St-Jean, Quebec. Mr. Martin Van Lierop, of Macdonald College, acted as supervisor of enumeration must be credited for skilful organization of the field work and for the collection of data.

Special thanks are extended to the corn growers who, with good will, gave their time in assisting farm enumerators.

Finally, we like to express our gratitude to Lewis A. Fischer and David L. MacFarlane who with the assistance of P. Vandenberghe were responsible for the study.

Dr. Gabriel S. Saab,
Farm Management Division,
Agriculture Canada,
Montreal, Quebec.

PRODUCTION PRACTICES, COSTS AND RETURNS IN QUEBEC
GRAIN CORN PRODUCTION

Grain corn is the most important of the feed grains in terms of world production and trade. About 45 percent of world feed grain production is corn. World grain corn production in 1970 was estimated at 242 million metric tons (9,680 million bushels) grown on some 107 million hectares (264 million acres) of land. United States production (averaging 4.6 billion bushels from 63.5 million acres in the past four years) represents about one-half of total world output.

As the major feed grain crop, corn production has responded to the generally buoyant and expanding markets for meats and other livestock products. The introduction of hybrid varieties, dating from the 1930's brought very large gains in yields per acre. More recently, the development of the corn combine or harvester has led to very large reductions in the hours of labour required to produce an acre of grain corn. Highly mechanized farms in Illinois have annual direct labour requirements of 3.0 to 4.5 hours per acre for growing and harvesting grain corn 1/. Cloutier cited an average labour requirement of 7.0 hours for the most efficient group of growers in the St.Hyacinthe area in 1968 2/. The development of high yielding hybrid seed resulted in the expansion of the "Corn Belt" as far as the Ottawa Valley in Ontario and the St. Lawrence Plains in the Province of Quebec. The phenomenal reduction in labour requirements, on the other hand, made grain corn fully competitive or more than competitive with other feed grains. The force of the above developments is reflected in the fact that the grain corn area in Canada rose from 314,000 acres in 1951 to 1,410,000 acres in 1971. Canadian production in the latter year was close to 110 million bushels. The major significance of this rapid increase in production is not only in the increased availability of feed grain, but also in the area of import substitution. In the early 1960's, Canada imported more than 70 million bushels of grain corn; in the past three years (1969-1971) imports averaged 13 million bushels.

The impact of the successful introduction of grain corn in Quebec has been spectacular. Prior to 1966 grain corn was so unimportant that it was not recorded in official annual agricultural statistics. By 1971 acreage had risen to 117,000 and production to more than 11 million bushels. The data relevant to tracing this very important development are presented in Table I. Note the very high yields per acre as shown in this table. Data on farm

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1/ Farm Management Manual, Department of Agricultural Economics, University of Illinois, AE 4281, January 1972.

2/ R. Cloutier, La Production des Plantes Industrielles dans la Région de Saint Hyacinthe, 1968, p. 105.

values of the crop are also presented. While official data on the value at the farm of the 1971 crop are not yet available, it is estimated at about 15 million dollars. In terms of the farm value, grain corn in Quebec is out-ranked only by tame hay, oats, and potatoes.

TABLE I: QUEBEC, GRAIN CORN STATISTICS, 1966-72

Year	Area, Acres	Yield per Acre, Bushels	Total Production, Bushels	Farm Price per bushel, Dollars	Total Farm Value, Thousands of Dollars
1966	17,700	63.1	1,117,000	1.50	1,676
1967	20,000	77.9	1,558,000	1.50	2,337
1968	30,000	84.5	2,535,000	1.35	3,422
1969	45,000	77.4	3,483,000	1.35	4,702
1970	93,400	78.0	7,285,000	1.40	10,199
1971	138,000	95.9	13,234,000	N.A.	N.A.
1972	140,000	67.0	9,380,000	N.A.	N.A.

Source: Statistics Canada, Catalogue No. 21-003 and 22-002.

In 1971, there were 2,530 grain corn producers in the Province. Almost half (1,192) were in Region VII. These growers cultivated 54 percent of the provincial acreage. Region VI had 734 growers (29 percent) with 30,414 acres or 26 percent of the total. The remaining 24 percent was distributed among Regions IV, VIII and X[1/] (See Figure I). In Quebec, even in areas where grain corn has now been successfully established, producers may yet be considered as innovators. For many, the decision to turn to grain corn production may still be regarded as conditional, meaning that they may require up to five years experience to decide whether to continue and/or expand the

1/ Data from Le Bureau de la Statistique du Québec, Avril 1972, miméo.

enterprise. Many farmers have rented land with the purpose of increasing grain corn acreage so as to benefit from the advantage of economies of scale.

Cloutier reports that in 1967 and 1968, respectively, 74 and 60 percent of total Quebec crop was used on the farms where it was produced. In 1971, only 25 percent of Quebec grain corn was used on the farms where it was produced. Of this, about one-third was fed to dairy cows and one-half to hogs 1/.

Production Conditions

Under favourable climatic conditions corn has a remarkable ability to adapt to different soil types. The soils in the areas where corn is successfully grown are mainly deep marine sediments, very fertile and capable of carrying a large variety of crops. Using St.Jean county as representative of the Quebec corn area, the land is composed of 14 percent heavy clay loam, 33 percent sandy clay loam, nine percent sandy loam, and five percent sand and/or muck land. The loams are located on both sides of the Richelieu River. This is the most productive area, combining good nutrient content with satisfactory drainage.

In many places, plastic tube drainage is increasingly used because of its low price and high durability. Good natural and/or artificial drainage is very important. Cloutier analyzed the availability of suitable land for the growing of grain corn in Agricultural Regions VI and VII, which constitute the "Corn Belt" of the Province. He found that a total of about 1,000,000 acres are available for the growing of industrial crops, with about 55 percent of this suitable for crops other than those now grown 2/. This agrees generally with the acreage classified as "optimum" in the Carte de Repérage, published by the Quebec Department of Agriculture and Colonization in 1968. This paper recorded about 5,200,000 acres of land in the St.Lawrence basin, of which about 500,000 were classified as "optimum" 3/. The geographical distribution of "optimum" land, as defined, is presented in Appendix I. It shows that some is located in areas which are outside the 2,500 heat-unit boundaries, the importance of which will be discussed later.

Professor J.F.G. Millette, of the Soil Science Department of McGill University, conducted extensive research on soil adaptability for grain and the influence of soil quality on its production 4/. Professor Millette was

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1/ Le Bureau de la Statistique, "Maïs Grain 1971", miméo.

2/ Op. cit., p.43

3/ The classes "optimum" includes all the soils for which the only limiting characteristics are acidity, and/or a lack of fertility.

4/ J.F.G. Millette and W.E. Searl, Indices de Capacité Agricole pour les Sols des Rapports Pédologiques de l'Est du Canada.

asked for a hypothetical assessment of soils which are suitable for grain corn production in Quebec. The result is shown in Table II. The quality of management of the soil over a period of years has a strong influence on its fertility. Over a ten-year period, some important characteristics of a soil are changed. The most important are: (1) pH; (2) content of nutrient element; (3) soil water distribution; and (4) stoniness. In view of this, one would expect a very different fertilizer-use programme in year 10 than in year 1. This is considered later.

Drainage plays an essential role in soil productivity in grain corn production in Quebec. Only well-drained soils warm up quickly in the spring. According to a Royal Commission report, only 1.5 percent of Quebec's cultivated area, i.e. 42,000 acres, was tile drained in 1966. This compared to 2.2 million acres tile drained in Ontario in 1963, or more than 30 percent of the cultivated area. Cloutier notes that the slow rate of drainage placement, i.e. 2,761 acres in 1966, 3,272 acres in 1967, and 9,859 in 1968, constituted a real deterrent to the expansion of grain corn production 1/. However, in each of the years 1970, 1971 and 1972 an estimated 30,000 acres have been under-drained.

The topography of the land also influences the adaptability to grain corn production. It affects the moisture distribution which affects depth and color of the soil and the tendency for erosion to occur.

The amount and distribution of precipitation as well as the extent of heat during the growing period are determining factors in grain corn production. The moisture retention capacity of the soil is also important. On heavy soils, excessive precipitation may have a negative effect.

Availability of heat is another limiting factor. "Heat units" are values which indicate the suitability of various areas to growing grain corn. The Corn Heat Unit (CHU) system rates the various hybrid seeds and the geographical area in the same terms, providing a basis for selecting hybrids with a suitable maturity rating for any particular area. The earliest maturing varieties of hybrid corn require a minimum of 2,500 heat units 2/.

The Quebec Department of Agriculture describes the grain corn area of Quebec as comprising much of the St.Lawrence Lowlands and part of the Ottawa River Valley. It is the area which has 2,500 to 2,800 corn heat units and soils as well as topographic conditions suitable for grain corn. This zone is almost identical with the area mapped in Figure I. The map is based on the investigations of the Soil Science Department of Macdonald College 3/. The map indicates that even in the region which has the necessary

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1/ Quoted from P. Marten, Corn in Quebec, unpublished study prepared for the Canada Department of Agriculture, 1970, p.5.

2/ M. Hardy, G. Lussier and R. Martineau, La Culture de Maïs, Publication 286, Ministère de l'Agriculture et de la Colonisation du Québec, p.4.

3/ Courtesy of Professor J.F.G. Millette.

TABLE II - QUEBEC, GRAIN CORN, ESTIMATED YIELDS BY SOIL SERIES

Soil Series	Bushels per Acre [1/]	
	Year One, Farmers Starts Growing Grain Corn	Year Ten, After First Grain Corn
Ste-Rosalie	85	145
Richelieu	85	145
St-Damase	70	150
Courval	70	150
Sabrevois	80	140
Howick	85	145
Ormstown	75	130
Bearbrook	80	135
Wendover	80	145
St-Laurent	85	145
Yamaska	70	125

1/ These values indicate the general direction of development. They should not be considered as predictions of yields to be realized.

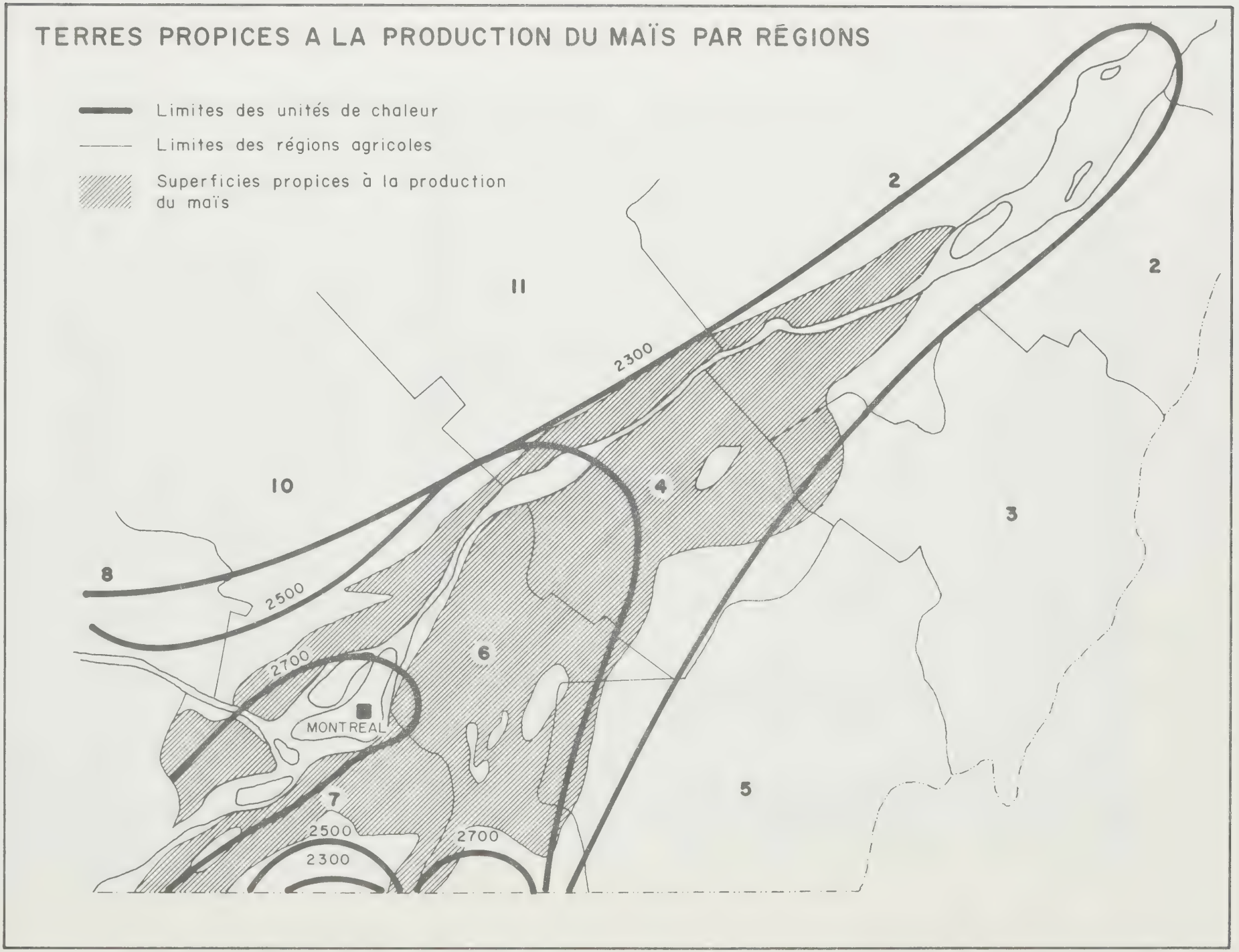
TERRES PROPICES A LA PRODUCTION DU MAÏS PAR RÉGIONS
Limites des unités de chaleur
Limites des régions agricoles
Superficies propices à la production du maïs
2
2
11
2300
10
4
3
8
2500
2700
6
MONTREAL
5
7
2500
2700
2300

FIGURE 1

heat average, there are spots which are not suitable for grain corn production due to topographic and soil characteristics. There is evidence that many farmers grow grain corn in areas outside the 2,500 heat boundary; however, they are generally aware of the risk involved in that decision. These farmers reason that if the corn does not reach maturity for grain, it will be used for silage.

Selecting the right variety is an important managerial decision. Considerations here are: (1) expected date of maturity; (2) strength of stem; and (3) disease resistance. In 1971, the Quebec Department of Agriculture listed the approved varieties for the various areas with 2,500 heat units or more. This list is presented in Appendix I. Farmers should use this information. But the following statement by Aldrich and Lang is cited with approval:

> No one hybrid can do all jobs equally well; what really is important is that your hybrid have consistently good performance under your growing conditions, and that it isn't grossly unsatisfactory under any conditions you can reasonably expect. This is one of the most difficult factors to judge in hybrid performance, but very important 1/.

The right amount of fertilizer to use will depend on the quantity of plant nutrients in the soil and the amounts used up by the crop. Clearly this varies in accordance with the yield. "The ears from a corn crop of 100 bushels per acre usually remove about 90 pounds of nitrogen, 18 pounds of phosphorus, and 25 pounds of potassium from each acre of soil" 2/. Table III presents fertilizer recommendations of the Quebec Department of Agriculture and Colonization. Some Quebec soils are deficient in magnesium and zinc. Farmers should seek advice on this subject. The recommendations refer to soils where no manure is applied in the actual crop year. Referring to Table III, it is suggested that nitrogen application be reduced by three pounds, that P_2O_5 be reduced by one pound, and the K_2O application by three pounds for each ton of cattle manure applied. Corn responds very favourably to use of manure.

Economic Survey of Quebec Grain Corn Farms

The major purpose of the survey was to collect data on farm organization, farm practices, costs and returns on the grain corn enterprise on Quebec farms. Being an enterprise analysis, it was necessary to allocate all

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1/ Aldrich, S.R. and E.R. Lang, "Modern Corn Production", The Farm Quarterly, F and W. Publishing Corp., Cincinnati, Ohio, 1969, Pp. 32-33.

2/ "Corn Production", United States Department of Agriculture, Agriculture Handbook No. 322, 1966, p. 9.

TABLE III: GRAIN CORN FERTILIZER RECOMMENDATIONS, POUNDS PER ACRE.

Level of Potassium (K_2O) in Soil									Time of application of fertilizers
POOR			AVERAGE			RICH			
N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O	
0	40	110	0	40	60	0	40	40	at cultivation
20	80	40	20	80	40	20	80	40	at or before seeding
10	0	0	110	0	0	110	0	0	before 12" height
130	120	150*	130	120	100	130	120	80	TOTAL
0	40	110	0	40	60	0	40	40	at cultivation
20	40	40	20	40	40	20	40	40	at or before seeding
110	0	0	110	0	0	110	0	0	before 12" height
130	80	150	130	80	100	130	80	80	TOTAL
0	0	120	0	0	70	0	0	50	at cultivation
15	60	30	15	60	30	15	60	30	at or before seeding
115	0	0	115	0	0	115	0	0	before 12" height
130	60	150	130	60	100	130	60	80	TOTAL

Source: Recommendation 1971, Publication 337, Quebec Department of Agriculture and Colonization, p. 105.

* At this low level of fertility, it may be difficult to obtain yields in relation to the fertilizers recommended.

relevant costs to the grain corn enterprise. The ultimate objective was to secure dollar and cents production costs for several situations which exist in Quebec. The assumptions underlying this cost study are detailed later as we treat each category of costs.

Method Used in Study

The survey is based on direct interviews with growers. This method is subject to limitations. First, among these, is that the data refer to performance of a single year. Another limitation is farmers' lack of records. Reliance is placed upon the farm operator's memory. On the other hand, this method enables the researcher to obtain up-to-date, first-hand information.

In planning the survey, it was necessary to find the most effective means of obtaining the desired information with the greatest possible precision, never losing sight of the costs involved in the survey itself. Consequently, a stratified random sampling method was employed. Stratified random sampling involves dividing the population of farms into mutually exclusive sub-populations, each of which is sampled independently.[1/] In view of the fact that some farmers are reluctant to or refuse to provide information, the method of sampling involved replacement for such cases.

The population was defined as excluding the growers with less than ten acres of grain corn. A total population of 1,677 producers was developed largely from lists provided by extension co-ordinators and agronomes. A ten percent sample was decided upon. In order to focus on problems associated with the size of business (and thus on scale problems in grain corn production) the universe was divided into four strata, I to IV, as follows:

Stratum	Acres in Grain Corn	Number of farms in Universe	Number of Farms in Sample
I	10-59	1,259	123
II	60-119	246	25
III	120-249	126	13
IV	250 and over	46	5
TOTAL		1,677	166

The geographic location of the 166 farms by size groups is presented in Figure II.

1/ In setting up the sampling techniques, helpful assistance was obtained from Professor M.A. Fanous, of Macdonald College, who is gratefully acknowledged.

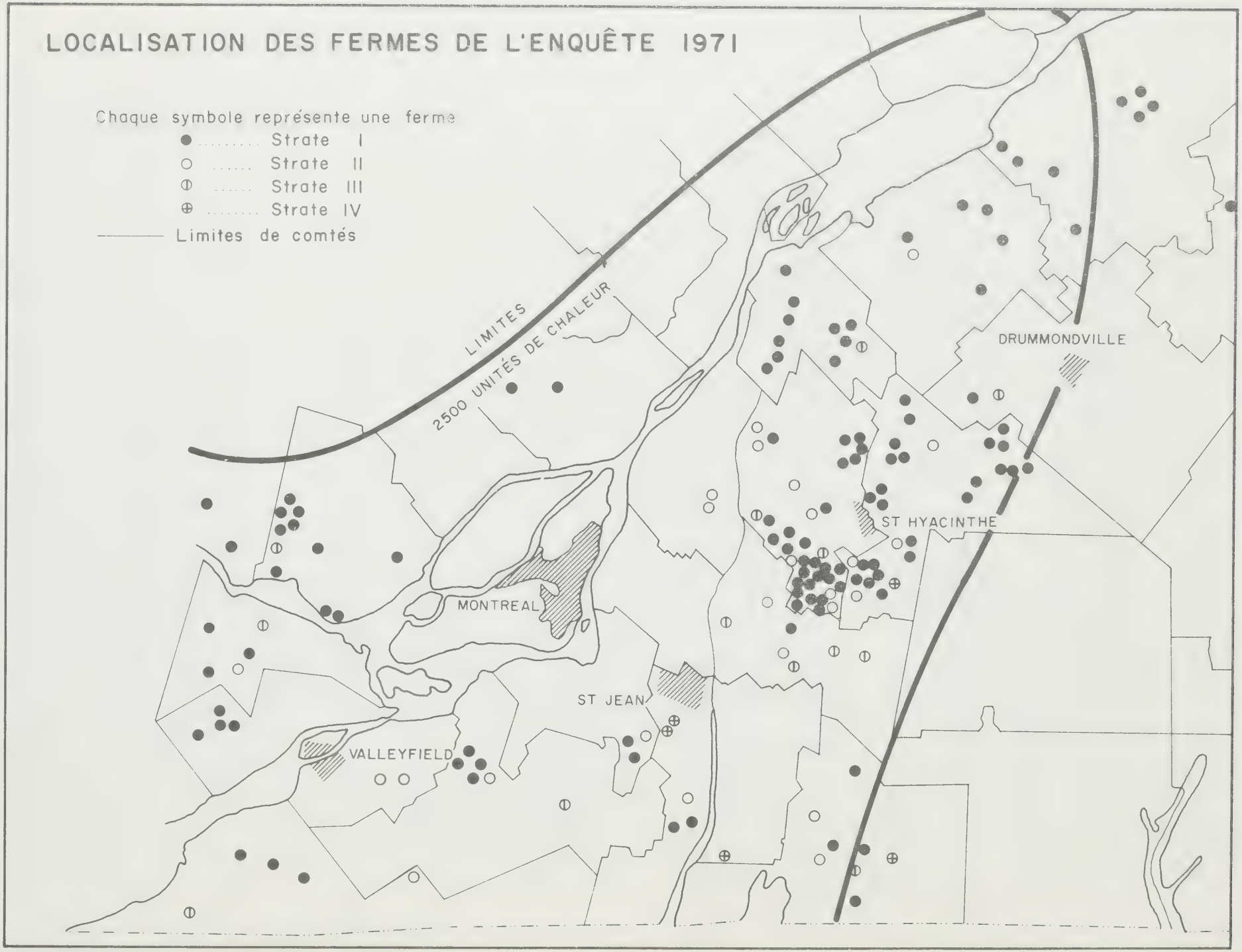
LOCALISATION DES FERMES DE L'ENQUÊTE 1971
Chaque symbole représente une ferme
Strate I
Strate II
Strate III
Strate IV
Limites de comtés
LIMITES
2500 UNITÉS DE CHALEUR
DRUMMONDVILLE
ST HYACINTHE
MONTREAL
ST JEAN
VALLEYFIELD

FIGURE II

Prior to the survey, many consultations were held with regional extension co-ordinators, county agronomes and farmers to resolve practical difficulties. Enumerators completed 261 farm visits. Out of these, 48 were preliminary interviews to pre-test the questionnaire. Forty-six farmers refused to co-operate and replacements were used. Two questionnaires were excluded for not being sufficiently complete.

Grain Corn on Farms

The farms surveyed had 21,307 acres of cultivated land in 1971 of which 48 percent was devoted to grain corn. These and other basic data about the 166 farms are presented in Table IV. Typically, these are family farms where very few operators employed full-time paid workers. It is evident from Table IV that 72 percent of the farms are in the cultivated-land category of 50 to 200 acres. This Table reveals that there was only one highly specialized grain corn farm among the 166. That farm had 437 acres of cultivated land, of which 378 were seeded to corn.

Statistics Canada reported average grain corn yields in Quebec at 78.8 and 95.9 bushels, respectively, in 1970 and 1971. The Bureau of Statistics of Quebec reported the following 1971 distribution by regions (bushels per acre):

Region IV	91.0
Region VI	99.5
Region VII	90.9
Region VIII	93.2
Region X	93.6

The distribution of acreages in grain corn and yields by strata for the survey farms are presented in Table V. In 1971, there was very little deviation from the average of 79.8 bushels per acre. Furthermore, 123 small farms, representing 74 percent of all farms surveyed, had average yields of 82 bushels per acre, or three bushels above the average. Among the 123 farms, there is a higher proportion of growers with five to six years of experience than among the 43 growers in the other strata. The small farmers also use more manure, which contributes to higher yields. The yields in 1970 show more fluctuation between strata and apparently is due to different weather conditions.

An interesting feature of the yield data is that the average yield of the farms surveyed is very close to the Ontario average (85 bushels per acre in 1970 and 81 bushels in 1971), and in excess of that of the United States, which was 71.7 bushels in 1970 and 86.8 bushels for 1971. But 1970 was the year of the serious blight infestation in the United States. Corn yields are increasing in the American Corn Belt. For instance, in Illinois the grain corn yield increased at an average rate of 2.69 bushels per acre per year since 1955. A continuation of yield increases in the Corn Belt of the United States is expected; but experience in that country shows that both weather and disease represent production hazards.

TABLE IV: QUEBEC, GRAIN CORN FARMS, CULTIVATED LAND AND GRAIN CORN PRODUCTION, 1971

Cultivated Land, Acres	Farms by Cultivated Land		Cultivated Land, Acres		Grain Corn		Production, Bushels	Yield per Acre, Bushels
	No.	Percent of Total	Total	Average per Farm	Total Acres	Acres per Farm		
0 - 49	20	12.0	286	14.3	884	44	67,750	76.6
50 - 99	50	30.1	3,867	77.3	2,209	44	186,986	84.6
100 - 149	43	25.9	5,154	119.9	1,934	45	148,779	76.9
150 - 199	27	16.3	4,683	173.4	2,411	89	176,605	73.2
200 - 249	11	6.6	2,431	221.0	616	56	53,936	87.5
250 - 299	7	4.8	1,945	277.9	929	133	77,470	83.3
300 - 349	2	1.2	622	310.8	325	162	28,282	87.0
350 - 399	3	1.9	1,159	386.4	256	82	23,162	90.5
400 - 499	1	0.6	437	437.0	378	378	26,840	71.0
450 and over	2	0.6	1,209	604.5	495	245	42,791	87.0
Total	166	100.0	21,793	-	10,437	-	832,601	-
Average	-	-	-	131	-	63	5,016	79.8

TABLE V: QUEBEC, GRAIN CORN, YIELDS ON SURVEY FARMS, 1970 AND 1971

Stratum	Number of Farms	1970 Acres Total	1970 Acres Average	1970 Production Bushels Total	1970 Production Bushels Average	1970 Yield Per Acres Bushels	1971 Acres Total	1971 Acres Average	1971 Production Bushels Total	1971 Production Bushels Average	1971 Yield Per Acre, Bushels
I	123	3,319	27	257,693	2,095	78.0	4,320	35	355,937	2,894	82.0
II	25	2,084	83	159,763	6,390	76.7	2,400	96	180,384	7,215	75.2
III	13	2,062	159	121,696	9,361	59.0	2,092	161	166,958	12,843	79.8
IV	5	1,340	268	113,390	22,670	84.6	1,626	325	129,529	25,905	79.6
Total	166	8,805	55	652,542	3,931	74.1	10,438	63	832,808	16,656	79.8

Our study shows that Quebec growers have reached high yield levels, and it is realistic to project further increases in areas where adequate climatic and soil conditions prevail. However, managerial skill will dominate further increases, since high yield is only one factor in profitable production. Importance must be attached to technology and to price relationship between inputs and outputs.

Labour

There are relatively few publications on labour use in grain corn production in Canada. Cloutier 1/ quotes the "Farm Business Management", of the Ontario Department of Agriculture and Food, as indicating 8.2 hours per acre in 1958-59. Since then, there has been a remarkable reduction in labour requirements. The 1965 issue of the same publication values the labour used at $8.73 to $9.18 per acre, which would represent about five hours of labour. A survey on 132 grain corn farms in Ontario in 1967 and 1968 found 2.5 hours per acre in grain corn growing and 2.2 hours per acre in harvesting 2/. The study does not include the hours used in transportation, storing, and drying the grain corn crop. A University of Illinois study of labour utilization in 1965 indicates 3.81 hours per acre used in growing, 1.7 hours in harvesting and putting in storage, and 0.22 hours of storage labour, for a total of 5.73 hours.

Table VI shows that almost half of the farms in the survey required between three and six hours of labour for grain corn growing, harvesting, drying and storing. Only eight used more than nine hours of labour, all of these in Strata I and II. The Table also reveals that the average labour hours used for the total operation fluctuated between 5.06 and 5.69 hours. As expected, the larger farms of Stratum IV used less labour than the other three categories. As a check on the above data, farmers were requested to estimate separately the money value of the labour used. This approach was desirable since farmers pay wages in accordance with local conditions and do not follow average wages in the Province. Some of the farmers interviewed had only vague recollection both of labour hours and labour costs. Therefore, 38 schedules were excluded from the analysis and do not appear in Table VI.

1/ Cloutier, op. cit., p. 12.

2/ Fisher, G.A. and I.R. Spence, Grain Corn Production in Ontario, Ontario Ministry of Agriculture and Food, 1972, page ix.

TABLE VI: QUEBEC, GRAIN CORN, LABOUR HOURS AND COSTS, 1971 [1/]

Stratum	No. of Farms in Stratum	Labour Hours - 3	Labour Hours 3-6	Labour Hours 6 and Over	Average Hours per Acre	Labour Cost Dollars per Acre
		(Percentage of farms)				
I	97	21	49	30	5.49	10.46
II	18	28	52	20	5.69	10.07
III	9	31	46	23	5.67	10.04
IV	4	40	20	40	5.06	8.32

Planting, Seeds, and Rotations

Moisture conditions are an important factor in plant population. In dry areas or seasons it is advantageous to keep the number of plants per acre at a lower level than in areas where favourable moisture conditions prevail. The Quebec Department of Agriculture and Colonization recommends 23,000 plants per acre. It is suggested that a 15 percent loss should be calculated. Thus, the recommended seeding rate is 26,400 per acre. Eighty-two percent of the farms surveyed had seeding rates between 20,000 and 29,000. All of the farmers in Stratum IV were in this range. The only marked deviation was in Stratum I, where about 17 percent of the farmers had more than 30,000 plants per acre.

The average seed cost was $5.00 per acre, with very little deviation between strata I, II and IV; Stratum III had $4.60 per acre. The average seeding cost for corn including labour, machinery,and custom-work farmers was $3.11 per acre, the highest ($3.68) in the first stratum and the lowest ($2.23) in Stratum IV.

Grain corn growing is fairly new to Quebec. In consequence, farmers have had limited experience in planning rotations with grain corn. Many of the larger farmers stated that they do not observe rotation at all. Some are in a continuous corn rotation. They recognize that they may encounter problems with disease and frankly state that they will change from continuous cropping when they have to. A few growers in the smaller size of farm groups claimed that they grow grain corn mainly after cereals and sometimes after vegetables. The small size-of-farm group (Stratum I) have the largest variety of crops, but only one-fifth had systematic rotations. Most of these indicated that their rotation is cereals--forage--grain corn; others were

1/ Both hour and labour costs as reported by farmers interviewed in the survey.

using cereal--cereal--grain corn; or forage--cereal--cereal--grain corn rotations.

Many farmers grew more than one variety. The most favoured varieties are United and Worwick, used by 19 and 18 percent of the growers, respectively. These were followed by De Kalb and Funk. Of the 166 growers, 159 planted the corn in May, five in June, and two in April.

Investment

Further consideration of the costs of grain corn production requires consideration of investment in the enterprise. Thus we refer to Table VII. It shows investment in land and buildings for the corn enterprise ranging from $176 per acre for the small-size group to $274 and $243 for the two large-size groups.

Commercial non-agricultural uses of land have influence on farm land values over much of the area. Also, presence or absence of tile drainage is important.

Table VII reveals that specialized growers rented relatively more land than the small scale operators. In Stratum I, rented land accounted for only 14 percent of total grain corn area while in Stratum IV it was 48 percent. The rent of one acre of land suitable for grain corn shows wide fluctuations; enumerators found rents of three to five dollars up to 30 and 35 dollars per acre. Apparently some rental arrangements are not strictly commercial transactions, undisclosed portions of rents are paid by providing housing or food products and so on. In general, average rent is less than seven percent of the land value.

Land use as depicted in Table VIII supports the fact that the large growers in Strata III and IV tend to be specialized farms, devoting 60-70 percent of cropped land to grain corn. On the other hand, farmers in Stratum I are using only 25 percent of their cropped land for grain corn, and produce predominantly hay and oats, evidently for animal feed.

Fertilizer

Corn reacts very favourably to fertilization, and Quebec farmers have the option of many fertilizers. Earlier the recommendations of the Quebec Government on fertilizer practices were presented. It is significant that there is a considerable difference between the recommendations for Ontario and those for Quebec. Ontario 1/ recommends an average of 205 and Quebec an average of 310 pounds of nutrients per acre (see Table III). It is even more significant that Quebec farmers tend to use more fertilizer than is recommended.

1/ Ontario Ministry of Agriculture and Food, Field Crop Recommendations, 1972 Bulletin No. 296, p. 8.

TABLE VII: QUEBEC GRAIN CORN, DISTRIBUTION OF INVESTMENT, 166 FARMS, 1971.

		Stratum I	Stratum II	Stratum III	Stratum IV
Number of Farms		123	25	13	4
Grain Corn Acreage	acres	4,320	2,400	2,092	1,297
Of which Rented	acres	635	628	670	627
Owned Grain Corn Land	acres	3,685	1,772	1,422	670
Value of Owned Land	$	568,048	308,524	364,418	150,439
Value of Building for Grain Corn	$	79,853	32,734	24,500	12,535
Land and Building for Grain Corn	$	647,901	341,258	388,918	162,974
Investment per Acre	$	176	192	274	243
Tile drained	acres	635	255	442	128
Percentage of Owned Land in Grain Corn	percent	17	14	31	19
Value of Machinery, Total	$	172,627	94,152	95,521	75,055
Per Acre of Corn Land (owned and rented)	$	39.96	39.23	45.65	52.22

TABLE VIII: QUEBEC GRAIN CORN FARMS, LAND USE BY CROPS ACRES IN GRAIN CORN 166 FARMS, 1971 PERCENT

	All Strata	I (10-59)	II(60-119)	III(120-249)	IV(250 and over)
Corn: grain	38	25	51	63	70
silage	7	7	6	7	1
sweet	1	1	3	1	2
Oats	11	16	4	3	-
Wheat	2	2	4	-	-
Hay	33	41	25	24	-
Sugar Beets	2	2	3	-	4
Peas	2	1	2	-	23
Other	4	5	2	2	-
	100	100	100	100	100

Table IX reveals that surveyed farmers have greatly exceeded the recommendations, particularly for phosphate and potash. Apart from the question about the material used, farmers were requested to estimate the money cost of fertilizer material used. These values are presented in the last column of Table IX.

On the question of farmers exceeding the recommended applications, agronomists stated that in the early years, after the adoption of grain corn as a crop, this practice is acceptable and actually to be expected. Thus, the recommendations relate to situations where grain corn has been in the rotation at least for more than a few years.

To examine the effect of increasing the amount of fertilizer used, the records were divided into four groups according to the quantity of nutrients applied. The results are presented in Table X. With one exception, yields increased with the increase of fertilizer applied, yet varied between groups indicating that fertilizer is only one of the factors which influence yields.

Plant Protection

Weed control is essential. Weeds that grow when the corn is small are very harmful. Therefore, sophisticated corn growers use pre-emergence weed control. Anthracin is the most popular of these herbicides in the Quebec corn area. Among injurious crop insects corn rootworms, corn earworms and the European corn borer are the most serious pests in grain corn production. However, infestation in Quebec is substantially lower than in the American Corn Belt where the annual losses due to these three pests amount to about ten percent of the crop 1/. Also, rots and blights are less important than in the United States. Actually, the largest single cost item is weed and insect control. The cost of pest control shows very little deviation in Strata I, II and IV standing between $4.74 and $4.98 per acre. In Stratum III, two farmers spent more than 11 dollars per acre and so the average for the 13 farms reached $6.60 per acre.

Machinery

Machinery operating costs were calculated separately for tractors and for other self-propelled machinery. Further, for each machinery operation on grain corn, such as seedbed preparation, protective treatment and drying, the hourly operational costs were determined. First, the number of hours the individual machine was in operation was obtained from the farmer and then an hourly rate per acre was applied to it. Variable machinery costs show little variation. They were the lowest in Stratum I ($2.40) and highest in Stratum III ($2.74). The large growers of Stratum IV recorded $2.62 per acre. These cost data are entered in Table XV. In all of the Strata, the highest variable machinery cost (average 40 percent) occurred in seedbed preparation, followed by harvesting (eight to ten percent). Most of the

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1/ Losses in Agriculture , U.S.D.A., Handbook No. 291, 1965, p. 42.

TABLE IX: QUEBEC, GRAIN CORN, NUTRIENTS APPLIED, RECOMMENDATIONS, AND FERTILIZATION COST PER ACRE, 157 FARMS - 1971.

	No. of Farms	N 1/	P_2O_5	K_2O	Total	Cost Per Acre ($)
Stratum I	123	126	123	158	407	34.32
Stratum II	17	135	137	129	401	37.41
Stratum III	13	145	147	169	461	38.79
Stratum IV	4	125	100	101	326	29.91
Recommended Average 2/		130	80	100	310	

1/ N content of manure is included.

2/ See Table III.

farmers in Strata III and IV own drying facilities. Their variable machinery cost in drying amounted to 10 to 15 percent of the total.

Since Quebec grain corn growers tend to be new to the business, much of the specialized machinery has recently been acquired. To avoid distortions, a standard method is applied to all machinery owned less than five years. This is based on the price paid and the year of purchase of each machine. For machines owned five or more years, it is assumed that the data provided by the farmer are reliable. By this time, he has likely been approached by dealers and is aware of the market value of his machinery. Thus, his estimate could be accepted. Fixed machinery cost included annual depreciation (in most cases on a ten-year basis), interest on investment at seven percent per year, repairs charged at eight percent of the beginning inventory, and maintenance and housing cost at two percent of beginning inventory. The summary of findings is presented in Table XI. It shows that the large growers who have the lowest labor also have the highest fixed machinery costs. But again, we note that almost all of these growers had their own drying and storage facilities.

Other Fixed Costs

Cost per year for the use of land in grain corn production consists of seven percent interest on owned land and actual rent of rented land. This is summarized in Table XII. Taxes are entered in the "miscellaneous costs" category. Farmers were requested to identify the buildings which serve grain corn production. Annual cost of specified buildings for the corn enterprise

TABLE X: QUEBEC GRAIN CORN, FERTILIZER NUTRIENTS APPLIED AND YIELDS, 157 FARMS, 1971

Fertilizer Nutrients Pounds	Stratum I		Stratum II		Stratum III		Stratum IV	
	No. of Farms	Yield per Acre Bu	No. of Farms	Yield per Acre Bu	No. of Farms	Yield per Acre Bu	No. of Farms	Yield per Acre Bu
No fertilizer	2	63.8	-	-	-	-	-	-
1 - 250	13	69.4	2	65.3	-	-	1	72.5
251 - 500	78	81.6	18	75.8	8	85.2	4	80.5
501 - 750	26	94.1	1	90.3	4	72.0	-	-
Total No. of Farms	119		21		12		5	
Average Yield, bu		82.9		75.01		78.01		79.60

TABLE XI: QUEBEC GRAIN CORN FARMS, FIXED MACHINERY COSTS, 157 FARMS, 1971.

Fixed Cost, Dollars per Acre	Number of Farms by Category and Stratum			
	Stratum I	Stratum II	Stratum III	Stratum IV
0 - 10	71	13	5	-
10.1 - 20	34	10	7	4
20.1 and over	12	1	-	-
No. of Farms	117	24	12	4
Average	$ 10.79	10.59	12.33	14.10

TABLE XII: QUEBEC GRAIN CORN FARMS, LAND COSTS, 162 FARMS, 1971.

Land Costs per Acre, Dollars	Number of Farms			
	Stratum I	Stratum II	Stratum III	Stratum IV
0 - 5	18	4	1	-
5.1 - 10	44	6	3	2
10.1 - 15	43	10	4	1
15.1 - 20	10	3	1	1
20.1 and over	6	2	3	-
Total	121	25	12	4
Average Cost per Acres Dollars	9.79	10.79	15.41	12.18

was based on a charge of seven percent interest on present market value as estimated by the farmer, five percent depreciation, and one percent maintenance cost.

Custom work has been treated as a special category of costs in this study. It generally includes expenses paid for hired services which include the use of machinery. However, in this work, cost of commission or brokerage and such other marketing costs are added under this heading. But by far the greatest outlays were for combining and drying corn. Table XIII shows that growers in Strata II, III and IV used custom work predominantly in harvesting, drying, and storage. Only farmers in Stratum I used as much as ten percent of total custom work outlays in pre-harvest work. On the other hand the large growers spent ten percent of custom work outlays on marketing which was largely devoted to hired trucking. As one would expect, the larger expenditures per acre on custom work on small farms offsets their smaller investment in machinery. This conclusion emerges from Table XV which summarizes costs.

Miscellaneous

In this category we include both municipal and school taxes paid by the farmer, taking into account rebates on school taxes by the provincial government. Further, we include electricity, insurance, and telephone costs and also costs of maintenance of roads and fences. It should be noted that the figures refer to amounts charged to grain corn.

TABLE XIV: QUEBEC GRAIN CORN FARMS, MISCELLANEOUS COSTS, 149 FARMS, 1971.

Stratum	Number of Farms	Miscellaneous Cost Per Acre ($)
I	109	6.07
II	23	5.51
III	13	2.82
IV	4	2.89
All Farms	149	5.61

Production Costs

Production cost data are summarized in Table XV. Total cost averaged $88.10 per acre for the large farms, and from $101 to $105 per acre in the other size groups. The higher costs in stratum III are largely related to the higher value placed on land. The majority of the farms in this group are in the St. Jean and St. Hyacinthe areas, where farmland is under the influence of industrialization. It is significant that the indicated scale

TABLE XIII: QUEBEC GRAIN CORN, CUSTOM WORK, 165 FARMS, 1971

	No. of Farms	Custom Work per Acre $	Percentage Distribution of Custom Work Expenses			
			Pre-harvest work	Harvest	Drying and Storage	Marketing
Stratum I	123	14.91	10	45	43	2
Stratum II	25	14.55	2	31	64	3
Stratum III	13	9.76	1	31	68	-
Stratum IV	4	6.50	7	4	79	10

economies have their origin in variable outlays alone and that they are due more to lower fertilizer costs per acre than to any other factor. It seems reasonable that the large scale operators have been in grain corn for longer periods and that the fertility of their land has been built up to a point where very heavy applications of fertilizer are no longer required.

Table XVI indicates that purchased inputs represent nearly half of total cost. The largest single outlay is for fertilizer.

Table XVII provides data on the distribution of cost by operations. Here it again points to the sources of the economies of scale. Both pre-harvest and harvest costs are considerably lower in the other categories than in the largest size group. The low expenditure by small growers is because many farmers put the crop into a crib at harvest time and store it without artificial drying until it is used. Many large scale farmers intend to sell the crop when the price is right. Consequently, he must have a marketable product on hand.

Comparison of Quebec grain corn production costs with those of Ontario and Illinois are of interest. The most recent publication of the Ontario Ministry of Agriculture and Food presents data of 1967-68 (Appendix Table II). There, materials account for about 40 percent of the total cost. However, outlays on fertilizers are much lower than in Quebec. Smaller quantities are used in Ontario and most fertilizers are cheaper than in Quebec. Thus, in Ontario the group with the highest total charges per acre spent $24.44 vs. $38.79 in Quebec. Quebec's small farms had lower (and the large farms higher) machinery cost than the corresponding Ontario growers. Land and building costs in Ontario are considerably higher than in Quebec, due largely to higher land prices.

Production costs in Illinois appear to be substantially higher than in Quebec. The per acre costs under continuous corn ranged from $125 to $139 per acre in the period 1968-1970. But fertilizer cost per acre was only $17 to $18. However, interest on investment and taxes were over $40 per acre each year. It is in this area that Quebec has the greatest advantage over the Corn Belt of the United States.

Marketing, Prices and Returns

Very little corn is sold as ear corn and prices in these sales are low. The small scale producers (Strata I and II) sold 38 and 52 percent, respectively, of the crop, partly at harvest time and partly between harvest and the time of survey (January to March, 1972). The marketing behaviour of the group in Stratum III was generally similar. However, in Stratum IV farmers sold 75 percent of the crop prior to the survey and had 25 percent in storage expecting better prices in the spring months. Data on the disposition of the 1971 crop are presented in Table XVIII.

TABLE XV: QUEBEC GRAIN CORN FARMS, PRODUCTION COSTS PER ACRE, 165 FARMS, 1971

Number of Schedules	Stratum I 123	Stratum II 25	Stratum III 13	Stratum IV 4
	$	$	$	$
I. Variable Costs:				
Labour	10.46	10.07	10.04	8.32
Machinery	2.40	2.48	2.74	2.62
Materials used:				
Seed	5.22	4.62	4.99	5.29
Fertilizers	34.32	37.41	38.79	29.91
Pesticides	4.98	4.74	6.60	4.89
Custom Work	14.91	14.55	9.76	6.50
Total Variable Cost	72.29	73.87	72.92	57.53
II. Fixed Costs:				
Machinery	10.79	10.59	12.33	14.10
Land-Use	9.79	10.79	15.41	12.18
Building Use	2.40	1.77	1.52	1.40
Other Fixed Costs	6.07	5.51	2.82	2.89
Total fixed Cost	29.05	28.66	32.08	30.57
Total Cost	101.34	102.53	105.00	88.10

TABLE XVI: QUEBEC GRAIN CORN FARMS, DISTRIBUTION OF COSTS FOR PURCHASED INPUTS, 165 FARMS, 1971.

Item	Strata			
	I	II	III	IV
	Percentage of Total Cost			
Purchased Inputs	44	46	48	46
Machinery (fixed and variable)	13	13	14	19
Labour	10	10	10	9
Land and Buildings	12	12	16	15
Custom Work	15	14	9	8
Miscellaneous Overheads	6	5	3	3
Total	100	100	100	100

TABLE XVII: QUEBEC GRAIN CORN FARMS, DISTRIBUTION OPERATIONS, 165 FARMS, 1971.

Strata:	I	II	III	IV
	Dollars Per Acre			
Seedbed Preparation	12.40	8.62	8.15	7.48
Planting	3.31	2.52	2.54	1.87
Plant Protection	2.09	1.87	1.70	1.97
Harvesting	10.98	9.68	7.84	6.93
Drying	7.06	11.70	11.09	10.38
Storage	2.41	2.65	3.02	1.96
Marketing	.31	.65	.53	.95
Miscellaneous	18.26	18.07	19.75	16.47
Purchased Materials	44.52	46.77	50.38	40.09
Total	101.34	102.53	105.00	88.10

Table XIX again reveals the disposition of the corn crop, but it introduces prices and estimates incomes. The price of $1.40 a bushel for stored grain corn is our estimate of current value in January - February 1972. The average March-July, 1972 price was $1.20 for Corn No. 2 in Chatham and $1.23 for Corn No. 3 in Chicago, indicating an average price of $1.50 for the area surveyed. As mentioned earlier, there is evidence that this price has rarely been obtained by local farmers.

Table XX presents data on returns. Since the operator's labour, as well as drying, storage, and some marketing costs are included as costs, the returns indicated are not to management.

Table XX provides comparative data indicating returns to management with prices assumed (a) at $1.40 at the farm; (b) $1.50 at the farm. This assumes the same proportions of the crop sold and stored as indicated in Table XIX. With improved marketing facilities and rational pricing the $150 figure is not unrealistic.

Farmers in Stratum IV stored or fed only 25 percent of their crop. Thus, a potential price increase of ten cents per bushel had relatively less effect on their net revenue than in the other strata.

Conclusion

Producers in the survey represent a good cross section of progressive family farms in the area. There were no corporate farms in the samples and very few operators hired help on an annual basis. In some cases, the operator owned the farm jointly with his brothers or sisters who participated in the operation. While grain corn production is relatively new in the Province, growers had grown silage corn for many years before undertaking grain corn production. But there was no significant correlation between grower's experience in grain production and profitability.

The difference in average yields between the four strata was not significant. Field evidence showed, however, that drainage is a very important factor. Of course, climatic condition, i.e., distribution both of heat units and precipitation, have a significant bearing on yields. The salient feature of the characteristics of the farms surveyed is that small and medium size farms are mixed farms using considerable part of the crop for feed while large scale specialized farms produce grain corn as a cash crop. Corn producers could increase returns by more efficient allocation of resources such as the use of more labour saving technology and economy in the use of purchased inputs. The high cost of custom work could be reduced by the use of jointly owned machinery. In Strata I and II custom work per acre amounted to $14.91 and $14.55 respectively; the average in Stratum IV was $6.50; and in Ontario for all sizes of farms, $7.54 in 1968.

Among purchased inputs items, fertilizer represented the highest outlay, at $35.24 per acre in 1971. An Iowa study (1970) shows outlays of $12.24, per acre and one for Ontario (1968) reported $23.82 per acre. The causes of these differences are numerous. Ontario recommends an average of 205 and Quebec an average of 310 pounds of nutrients per acre. The farmers in the

TABLE XVIII: QUEBEC GRAIN CORN FARMS: DISPOSITION OF CROP, 165 FARMS, 1971-72[1]

Stratum	Sold at Harvest Time				Sold after Harvest				Production 1000 bu
	Shelled Corn		Ear Corn		Prior to Survey shelled, dried		Stored or Fed		
	1000 bushels	Percentage of Crop	1000 bushels	Percentage of Crop	1000 bushels	Percentage of Crop	1000 bushels	Percentage of Crop	
I	116	33	5	1	18	5	217	61	356
II	75	42	2	1	19	10	84	47	180
III	55	33	-	-	45	27	67	40	167
IV	20	15	-	-	80	60	30	25	130
Total	266	32	7	1	162	19	398	48	833

[1] All converted to 15.5 percent moisture.

TABLE XIX: QUEBEC GRAIN CORN FARMS, DISPOSITION OF CROP, PRICES AND INCOME, 165 FARMS, 1971-72[1]

Kind of Sales	Stratum I			Stratum II			Stratum III			Stratum IV		
		Price			Price			Price			Price	
	Sales 1000 bu	per bu $	Sales $	Sales 1000 bu	per bu $	Sales $	Sales 1000 bu	per bu $	Sales $	Sales 1000 bu	per bu $	Sales $
At Harvest:												
Shelled	116	1.20	139,200	75	1.17	87,750	55	1.25	68,750	20	1.18	23,600
Ear	5	1.13	5,650	2	0.90	1,800	-	-	-	-	-	-
After Harvest:	18	1.36	24,480	19	1.36	25,840	45	1.25	56,250	80	1.30	104,000
Stored or Fed[2]	217	1.40	303,800	84	1.40	117,600	67	1.40	93,800	30	1.40	42,000
Total	356		473,130	180		232,990	167		218,800	130		169,600
Average Price per Bushel		1.33			1.30			1.31			1.31	

[1] Basis 15.5 percent moisture.

[2] Estimate of current value.

TABLE XX: QUEBEC GRAIN CORN FARMS, RETURNS PER ACRE AND PER BUSHEL, 165 FARMS, 1971-72

	Per Acre			Per Bushel		
	Gross Return	Cost	Net Return	Gross Return	Cost	Net Return
Stratum I						
Farm Value $1.40 per bu.	109.52	101.34	8.18	1.33	1.24	0.09
Farm Value $1.50 per bu.	114.54	101.34	13.20	1.39	1.24	0.15
Stratum II						
Farm Value $1.40 per bu.	95.51	102.53	-7.02	1.29	1.36	-.09
Farm Value $1.50 per bu.	100.57	102.53	-1.96	1.34	1.36	-.04
Stratum III						
Farm Value $1.40 per bu.	104.58	105.00	- .42	1.31	1.32	-.01
Farm Value $1.50 per bu.	107.79	105.00	2.79	1.35	1.32	.03
Stratum IV						
Farm Value $1.40 per bu.	104.31	88.10	16.21	1.31	1.11	.20
Farm Value $1.50 per bu.	106.15	88.10	18.05	1.33	1.11	.23

survey used 404 pounds of nutrients per acre, almost equally distributed between the three nutrients: nitrogen, phosphate and potash. In Ontario, the average application of N-P-K by all producers was 247 pounds per acre, (Fisher, 1972, page 42). In Iowa the total nutrient applied was 240 pounds. One of the most commonly used fertilizers, 5-20-20, cost an average of $78 in Ontario (1968) and $95.50 per ton in Quebec (1971). (There has been very little change from 1968 to 1971 in the Ontario price). Converted in general terms, one pound of nutrient costs ten cents in Quebec, eight cents in Ontario, and five cents in Iowa. Discounts from the above prices are offered to farmers. We could not establish that markedly different discount patterns apply in the three areas.

Quebec grain corn growers have established or are on the way to establishing a cost advantage vis-a-vis Ontario and United States producers. There are two major constraints; heat unit limitations and high unit input costs. Possible losses from the former may in part be met by combining corn production with commercial livestock production. Then, if climatic conditions hinder full maturity of the grain corn, silage for animal feed may be a profitable option. This option has long been practiced on the geographic margins of the Corn Belt.

Individual producers can reduce input costs by their efficient application. This requires knowledge of modern technology. This includes improved knowledge of machinery use. Groups of producers either through a co-operative or some form of loose collaboration could overcome some of the problems involved in high custom rates.

There are several ways to reduce fertilizer cost including:

(a) increased application of manure which may be brought from commercial livestock enterprises;

(b) using the cheapest compounds and bulk materials available on the market;

(c) applying plant nutrients only in the quantities which are really necessary.

Farmers' lack of market awareness is another restraint. This could in some measure be overcome by extension courses on marketing. In addition, improvement in the market infrastructure itself is required.

Recommendations

At the Enterprise Level.

Mixed farms with less than 200 acres of grain corn should consider integrated livestock and corn production. Most do now.

Grain corn must be produced as efficiently as possible. Custom work and fertilizer outlays should be reduced. Farmers should establish closer contact with extension workers to obtain information about the right combination of

inputs. Drying and storage facilities should be improved; cribs and silos should be constructed on a more permanent basis than they have in the first few years of grain corn production.

Large size, specialized farms with grain corn acreage of 200 or 250 acres and more should proceed toward further improvement in production techniques. Further is the need for greater knowledge of marketing. This includes awareness of the advantages which may be realized by integrated arrangements with feed mills and distillers. Most important there appears to be a need for moderate level loans, e.g. $1 per bushel on farm stored grain corn. Such loans could be advanced by caisses populaires, banks, or a governmental credit agency on the basis of grain stored under a "seal". But this problem lies in the field of marketing, and requires close study.

At the Institutional Level.

Improved extension services both in the areas of crop production and livestock feeding are required. Most of the small and medium size producers had little knowledge of energy and protein requirements and did not seem able to assess losses due to inadequate drying and storage of grain corn. Further, we have already pointed to the need for more adequate facilities.

Further research on fertilizer use, on animal nutrition in relation to grain corn, as well as in marketing should be supported.

APPENDIX I: QUEBEC, GRAIN CORN, RECOMMENDED HYBRIDS [1/]

Hybrids	Yield, Bushels Per Acre, 15 Percent Moisture.
2,500 Heat Units	
Acco DC 103 (Haapala H-175)	89.2
Belle River 14	98.6
De Kalb 29	116.7
M.C. 101	114.4
N.K. PX417	105.5
N.K. X7868	83.7
Stewart's 3509	93.3
Stewart's 2408	96.1
2,600 Heat Units	
Co-op S-260	143.1
De Kalb DK22	109.3
De Kalb XL 301	123.0
Funk's G-4170	106.2
Funk's G-4082	124.0
N.K. KE410	114.7
N.K. S71343	119.4
P-A-G SX 42	128.1
P-A-G SX 44	151.7
P-A-G 14794	131.4
Pioneer 3889	111.9
Pioneer 3972	123.1
Pioneer 3873	128.2
Pride 109	109.9
Pride R 101	107.2
United Hagie 108	125.8
United Hagie 106	124.0
United Hagie 4	120.6
Warwick S.L. 209	117.2
Warwick 261	137.3
Warwick 214	120.4
Warwick 2035	101.2
Warwick TX 21	111.8

Source: Recommandations 1971 Grande Culture, Publication 337, Quebec Department of Agriculture and Colonization, pp. 101-103.

1/ Based on trials at stations located at Ormstown, St. Hyacinthe and L'Assomption.

APPENDIX TABLE II: ONTARIO GRAIN CORN FARMS, PRODUCTION COSTS PER ACRE, 1967 AND 1968.

	All records	1967	1968
N-P-K per acre, pounds	247	251	243
Manure per acre, tons a/	4.85	5.14	4.61
		dollars	
Land (fixed)	18.43	19.19	17.76
Labor (Operating) - Custom	1.33	1.53	1.16
(Operating) - Hired b/	.58	.25	.85
(Fixed) - Operator	5.34	5.52	5.21
Total	7.25	7.30	7.22
Materials			
Seed and Seed Treatment	4.29	4.18	4.38
Fertilizer	19.43	19.86	19.06
Manure Charges	4.62	4.46	4.76
Sprays and Oils	5.34	5.64	5.07
Other	1.40	1.53	1.31
Total	35.08	35.67	34.58
Tractor (Operating)	2.45	2.37	2.52
(Fixed)	3.67	3.56	3.77
Total	6.12	5.93	6.29
Machine (Operating)	1.98	2.01	1.96
(Fixed)	7.92	8.03	7.82
Total	9.90	10.04	9.78
Residual manure (operating)	.68	.65	.70
Custom work (operating) c/	7.85	8.22	7.54
Building costs (fixed)	2.08	2.24	1.93
Other (operating) d/	.25	.08	.39
Total operating costs	50.20	50.78	49.70
Total fixed costs	37.44	38.54	36.49
Total Costs Per Acre	87.64	89.32	86.19
Cost items		percent	
Land	21	21	21
Labor	8	8	8
Material	40	40	40
Tractor and Machinery	18	18	19
Building	3	3	2
Other e/	1	1	1
Total	100	100	100

Source: Fisher, G.A. and I.R. Spence, Grain Corn Production in Ontario, Ontario Ministry of Agriculture and Food, 1972.

(continued)

a/ Total tons manure applied in current, previous and 2nd previous years.

b/ Hired labor, meals, fringe benefits such as C.P.P., workmen's comp, etc.

c/ Custom machine and tractor.

d/ Hydro, telephone, crop insurance, farm liability.

e/ Also includes residual manure.